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Anna Esposito Antonietta M. Esposito
Alessandro Vinciarelli Rüdiger Hoffmann
Vincent C. Müller (Eds.)

Cognitive Behavioural Systems

COST 2102 International Training School
Dresden, Germany, February 2011
Revised Selected Papers



EUCOG II



Social Signal Processing Network

 Springer

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This book is dedicated to endings and to what is left behind

Preface

This volume brings together the advanced research results obtained by the European COST Action 2102 “Cross Modal Analysis of Verbal and Nonverbal Communication”, primarily discussed at the EUCogII-SSPNet-COST2102 International Training School on “Cognitive Behavioural Systems”, held in Dresden, Germany, February 21–26 2011 (www.ias.et.tu-dresden.de/ias/cost-2102/).

The school was jointly sponsored by the European Cooperation in Science and Technology (COST, www.cost.eu) in the domain of Information and Communication Technologies (ICT) for disseminating the advances of the research activities developed within the COST Action 2102: “Cross-Modal Analysis of Verbal and Nonverbal Communication” (cost2102.cs.stir.ac.uk); by the European Network of Excellence on Social Signal Processing (SSPNet, www.sspnet.eu) and by the 2nd European Network for the Advancement of Artificial Cognitive Systems, Interaction and Robotics (EUCogII, www.eucognition.org/).

The main focus of the school was on Cognitive Behavioural Systems. In previous meetings, EUCogII-SSPNet-COST2102 focused on the importance of data processing for gaining enactive knowledge, as well as on the discovery of new processing possibilities that account for new data analysis approaches, coordination of the data flow through synchronization and temporal organization and optimization of the extracted features. The next step will be to discover more natural and intuitive approaches for modelling and uncovering the wealth of information conveyed by humans during interaction for developing realistic and socially believable agents. This moves the research focus to cognitive systems and models of cognitive processes. It has been shown that cognitive processes – such as inference, categorization and memory – are not independent of their physical instantiations. Individual choices, perception and actions emerge and are dynamically affected/enhanced by the interaction between sensory-motor systems and the inhabited environment (including the organizational, cultural and physical context). This interplay carries up instantiations of cognitive behavioural systems.

How can these aspects be modelled in order to bring machine intelligence close to human expectations? Are existing paradigms sufficient or is more research needed on signals and data? How trustful, credible and satisfactory will emotionally-coloured multimodal systems appear to the end user? How will their physical instantiation and appearance affect the human-machine interplay?

The papers accepted in this volume were peer reviewed and include original contributions from early stage researchers. The volume presents new and original research results in the field of human-machine interaction inspired by cognitive behavioural human-human interaction features. The themes covered are cognitive and computational social information processing, emotional and socially believable Human-Computer Interaction (HCI) systems, behavioural and

contextual analysis of interactions, embodiment, perception, linguistics, semantics and sentiment analysis in dialogues and interactions, and algorithmic and computational issues for the automatic recognition and synthesis of emotional states.

The contents have been divided into two scientific sections according to a rough thematic classification. The first section, “Computational Issues in Cognitive Systems”, deals with models, algorithms, and heuristic strategies for the recognition and synthesis of behavioural data. The second section, “Behavioural Issues in Cognitive Systems”, presents original studies that provide theoretical and behavioural analyses on linguistic and paralinguistic expressions, actions, body movements and activities in human interaction.

The papers included in this book benefited from the lively interactions between the many participants of the successful meeting in Dresden. Over 100 senior and junior researchers gathered for the event.

The editors would like to thank the Management Board of the SSPNet and the ESF COST- ICT Programme for their support in the realization of the school and the publication of this volume. Acknowledgements go in particular to the COST Science Officers, Guseppe Lugano, Matteo Razzanelli, and Aranzazu Sanchez, and the COST 2102 rapporteur, Guntar Balodis, for their constant help, guidance and encouragement. The event owes its success to more individuals than can be named, but notably the members of the Dresden Local Steering Committee, who actively operated for the success of the event. Special appreciation goes to the President of the International Institute for Advanced Scientific Studies (IIASS), and to the Dean and the Director of the Faculty and the Department of Psychology at the Second University of Naples for making available people and resources for editing this volume. The editors are deeply indebted to the contributors for making this book a scientifically stimulating compilation of new and original ideas and to the members of the COST 2102 International Scientific Committee for their rigorous and invaluable scientific revisions, dedication, and priceless selection process.

July 2012

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- SSPnet: European Network on Social Signal Processing, <http://sspnet.eu/>



The ability to understand and manage social signals of a person we are communicating with is the core of social intelligence. Social intelligence is a facet of human intelligence that has been argued to be indispensable and perhaps the most important for success in life. Although each one of us understands the importance of social signals in everyday life situations, and in spite of recent advances in machine analysis and synthesis of relevant behavioral cues like blinks, smiles, crossed arms, head nods, laughter, etc., the research efforts in machine analysis and synthesis of human social signals like empathy, politeness, and (dis)agreement, are few and tentative. The main reasons for this are the absence of a research agenda and the lack of suitable resources for experimentation.

The mission of the SSPNet is to create a sufficient momentum by integrating an existing large amount of knowledge and available resources in Social Signal Processing (SSP) research domains including cognitive modeling, machine understanding, and synthesizing social behavior, and so:

- Enable the creation of the European and world research agenda in SSP;
- Provide efficient and effective access to SSP-relevant tools and data repositories to the research community within and beyond the SSPNet, and
- Further develop complementary and multidisciplinary expertise necessary for pushing forward the cutting edge of the research in SSP.

The collective SSPNet research effort is directed towards integration of existing SSP theories and technologies, and towards identification and exploration of potentials and limitations in SSP. More specifically, the framework of the SSPNet will revolve around two research foci selected for their primacy and significance: Human-Human Interaction (HHI) and Human-Computer Interaction (HCI). A particular scientific challenge that binds the SSPNet partners is the synergetic combination of human-human interaction models, and automated tools for human behavior sensing and synthesis, within socially-adept multimodal interfaces.

- **EUCogII: 2nd European Network for the *Advancement of Artificial Cognitive Systems, Interaction and Robotics***
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